

REMARKS

The Office Action dated February 12, 2004, has been received and reviewed.

Claims 1-28 are currently pending and under consideration in the above-referenced application. Each of claims 1-28 stands rejected.

Reconsideration of the above-referenced application is respectfully requested.

Objection to Amendment Under 35 U.S.C. § 132

The Office has objected to the claim revisions that were presented in the Amendment dated January 2, 2004, under 35 U.S.C. § 132 because they “introduce[] new matter into the disclosure.”

Merriam-Webster’s Collegiate Dictionary, Tenth Edition, defines “minimal” as “the least possible,” which includes “zero.” When used to indicate the amount of an exposed, doped region (*e.g.*, active-device region) of a semiconductor substrate that may be consumed as a metal silicide is deposited, the term “minimal” clearly indicates that such deposition may occur without reacting any of the material of the exposed, doped region.

Moreover, U.S. Patents 5,240,739 and 5,376,405, the disclosures of both of which have been incorporated by reference into the above-referenced application, provide: “TiSi_x can be *deposited directly as opposed to a result of substrate reaction* with elemental titanium. One way is by low pressure chemical vapor deposition using titanium tetrachloride and silane . . .” U.S. Patent 5,240,739, col. 2, lines 33-36 (emphasis supplied); U.S. Patent 5,376,405, col. 2, lines 38-41 (emphasis supplied). Thus, both of these patents, and the above-referenced application, indicate that TiSi_x may be deposited without reacting material of an exposed, doped region of a semiconductor substrate.

For these reasons, it is respectfully submitted that the claim amendments that were presented in the Amendment of January 2, 2004, do not introduce new matter into the above-referenced application. It is, therefore, respectfully requested that the 35 U.S.C. § 132 objections to the claims be withdrawn.

Rejections Under 35 U.S.C. § 103(a)

Each of claims 1-28 has been rejected under 35 U.S.C. § 103(a).

The standard for establishing and maintaining a rejection under 35 U.S.C. § 103(a) is set forth in M.P.E.P. § 706.02(j), which provides:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Hrzek in View of Levine

Claims 1, 8-13, 15-17, 20, and 23-28 stand rejected under 35 U.S.C. § 103(a) for being directed to subject matter which is allegedly unpatentable over the subject matter taught in U.S. Patent 3,801,365 to Hrzek (hereinafter "Hrzek"), in view of teachings from U.S. Patent 5,989,999 to Levine et al. (hereinafter "Levine").

Hrzek teaches a process for forming conductive structures, including metal silicide contacts. Although Hrzek refers to the disclosed process as a metal silicide "deposition" process, it is clear that the metal silicide is not deposited onto a silicon wafer (*i.e.*, formed above the silicon wafer) but, rather, is formed as the product of a reaction that occurs at the surface of the silicon wafer.

The process that is taught in Hrzek includes introducing a mixture that includes sublimated molybdenum pentachloride, hydrogen, and argon onto the surface of a heated silicon wafer. Col. 6, lines 27-47. A reaction occurs as the metal pentachloride contacts the heated silicon: the metal pentachloride purportedly gives off elemental chlorine and forms a metal subchloride. Col. 3, lines 45-49. The elemental chloride purportedly reacts with the silicon of the wafer, or substrate, to form a silicon chloride. The silicon chloride then purportedly reacts with the metal subchloride to form the metal (*i.e.*, molybdenum) silicide. Col. 3, lines 49-53.

Thus, it is evident from the teachings of Hrzek that the process disclosed therein includes the consumption of silicon atoms from the surface of a silicon wafer, or substrate, to form a metal silicide (*i.e.*, molybdenum silicide) at that surface. Thus, the metal silicide is not *deposited onto* the surface of the silicon wafer.

Hrzek is also silent as to the subsequent formation of a metal nitride over the metal silicide. Rather, the teachings of Hrzek are limited to forming metal silicide of various types (*e.g.*, MoSi₂, then Mo₃Si), then metal (*e.g.*, Mo). Col. 7, lines 45-50.

Levine teaches processes for forming metal nitride barrier layers. The process of Levine includes depositing a metal nitride onto silicon (col. 4, lines 20-29; col. 15, lines 48-51), annealing the metal nitride (col. 4, lines 30-42; col. 15, lines 48-51), then oxidizing (col. 4, lines 43-46; col. 28, lines 42-46) or “stuffing” the metal nitride with silicon atoms (col. 4, lines 46-48; col. 32, lines 52-59). Levine also teaches that all of these processes may be conducted in the same chamber, or *in situ*. Col. 4, lines 49-55.

Levine does not teach that the metal nitride barrier layers thereof may be formed on metal silicide structures, let alone *in situ* with the formation of metal silicide structures.

Independent claim 1 of the above-referenced application recites a method for fabricating an interconnect adjacent to a contact of a semiconductor device structure. The method of independent claim 1 includes causing a chemical reaction adjacent to a surface on top of at least one exposed, doped area of the semiconductor device structure. The chemical reaction selectively deposits metal silicide “without reacting material of the at least one exposed, doped area.” In addition, the method of independent claim 1 includes depositing an interconnect material onto the metal silicide *in situ* with deposition of the metal silicide.

Independent claim 20 of the above-referenced application is directed to a method for fabricating a selective contact and a local interconnect on a semiconductor device structure. In that method, a chemical reaction occurs adjacent to an exposed active device region of the semiconductor device structure. In the chemical reaction, a contact material is selectively deposited without substantially reacting a material of the active device region. Interconnect material is deposited *in situ* with deposition of the contact material.

It is respectfully submitted that a *prima facie* case of obviousness has not been established against any of claims 1, 8-13, 15-17, 20, or 23-28 for several reasons.

First, it is respectfully submitted that Hrzek and Levine, taken either separately or individually, do not teach or suggest each and every element of any of claims 1, 8-13, 15-17, 20, or 23-28.

In particular, neither Hrzek nor Levine teaches or suggests formation of a metal silicide (*e.g.*, by a chemical reaction) “without reacting material of” a semiconductor substrate (*e.g.*, at an exposed, doped area, active device region, etc.). To the contrary, Hrzek, at col. 7, lines 10-20, teaches:

When the molybdenum silicide layer is selectively deposited in the area of pore 64, **the layer 68 of molybdenum silicide grows, as a result of the reaction, into the silicon material extending slightly below the original level 66 of pore 64 as shown. The interface between the molybdenum silicide layer and the silicon in the underlying parts of the wafer is usually ragged and irregular**, providing for intimate, increased contact between the two phases and resulting in excellent adherence of the contact material to the semiconductor silicon. (Emphasis supplied).

Thus, the process that is taught in Hrzek includes the consumption of silicon atoms at the surface of a silicon wafer forms a metal silicide at that surface, and into that surface. Levine similarly fails to teach that a metal silicide may be formed without reacting material of a semiconductor substrate.

Further, Hrzek and Levine both lack any teaching or suggestion of the deposition of a metal nitride layer over a metal silicide structure. Instead, the teachings of Hrzek are limited to the deposition of metal (*e.g.*, molybdenum) directly onto metal silicide (*e.g.*, Mo_3Si). Col. 7, lines 45-50. Thereafter, a layer 80 (FIG. 3) of semiconductor memory material, which is a material that, in a first state has high electrical resistance and in a second state has low electrical resistance (*see*, U.S. Patents 3,271,591 and 3,530,441, both of which are cited and incorporated by reference into Hrzek), not a metal nitride, may be formed over the metal silicide structure. In

Levine, a metal nitride layer, formed by deposition and annealing processes, contacts a conductive region 105 of a silicon substrate 101. Col. 3, lines 5-23.

Therefore, Hrzek and Levine, taken either together or separately, do not teach or suggest each and every element of either independent claim 1 or independent claim 20, as would be required to establish a *prima facie* case of obviousness against these claims.

As Hrzek and Levine do not teach or suggest each and every element of independent claim 1, these references cannot teach or suggest each and every element of any of claims 8-13 or 15-17, each of which depends either directly or indirectly from independent claim 1. Likewise, Hrzek and Levine cannot teach or suggest each and every element of any of claims 23-28, as each of these claims depends either directly or indirectly from claim 20, which is allowable.

Second, it is respectfully submitted that, because Hrzek teaches a process for forming metal silicides that includes consumption of silicon atoms at the surface of a silicon wafer, Hrzek teaches away from the subject matter recited in independent claims 1 and 20, as well as from the subject matter recited in claims 8-13 and 15-17, which depend from claim 1, and claims 23-28, which depend from claim 20.

Moreover, as neither Hrzek nor Levine teaches or suggests that a metal silicide layer and a metal nitride layer could be formed *in situ* or even used in conjunction with one another, it is respectfully submitted that these references would not have provided one of ordinary skill in the art with any motivation to combine their teachings in the manner that has been asserted in the outstanding Office Action.

Rather, due to the fact that there is not motivation or suggestion in these references that would provide one of ordinary skill in the art with some motivation or suggestion to link their teachings, it appears that the only source for such motivation could have been the teachings of the above-referenced application. Therefore, it is respectfully submitted that the asserted combination of Hrzek and Levine could only have been based on improper hindsight provided by the teachings of the above-referenced application.

Without any motivation for one of ordinary skill in the art to combine the teachings of two or more references, the references cannot be relied upon to establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a).

Third, since Hrzek teaches away from the subject matter recited in claims 1, 8-13, 15-17, 20, and 23-28, or, more specifically, from a process which includes causing a chemical reaction that results in the formation of a metal silicide without reacting material of a substrate upon which the metal silicide is formed, it is respectfully submitted that one of ordinary skill in the art would not, before the priority date for the above-referenced application, have been motivated to combine the teachings of Hrzek and Levine in the manner that has been asserted.

Fourth, it is respectfully submitted that one of ordinary skill in the art would have had no reason to expect the asserted combination of Hrzek and Levine to be successful. In particular, when the teachings of Hrzek and Levine are considered in their entirety, as required by M.P.E.P. § 2141.02, it is clear that there would be no way to intersperse the process of Levine in between the metal silicide deposition and metal deposition portions of the process of Hrzek.

In view of the foregoing, it is respectfully submitted that Hrzek and Levine do not support a *prima facie* case of obviousness against any of claims 1, 8-13, 15-17, 20, or 23-28.

Claims 11 and 24 are further allowable since Hrzek and Levine both lack any teaching or suggestion of depositing an interconnect material *selectively* onto a metal silicide (claim 11) or contact material (claim 24).

It is, therefore, respectfully submitted that, under 35 U.S.C. § 103(a), each of claims 1, 8-13, 15-17, 20, and 23-28 is allowable over the asserted combination of Hrzek and Levine.

Hrzek, Levine, and Chang

Claims 2-5, 21, and 22 are rejected under 35 U.S.C. § 103(a) for reciting subject matter which is purportedly unpatentable over the teachings of Hrzek, in view of teachings from Levine and, further, in view of the subject matter taught in U.S. Patent 5,043,299 to Chang et al. (hereinafter "Chang").

Each of claims 2-5 is allowable, among other reasons, for depending either directly or indirectly from claim 1, which is allowable.

Claims 21 and 22 are both allowable, among other reasons, for respectively depending directly and indirectly from claim 20, which is allowable.

Hrzek, Levine, and Kolar

Claims 6 and 7 have been rejected under 35 U.S.C. § 103(a) for being drawn to subject matter which is purportedly unpatentable over teachings from Hrzek, in view of the subject matter taught in Levine and, further, in view of teachings from U.S. Patent 5,162,259 to Kolar et al. (hereinafter “Kolar”).

Claims 6 and 7 are both allowable, among other reasons, for respectively depending directly and indirectly from claim 1, which is allowable.

Hrzek, Levine, and Park

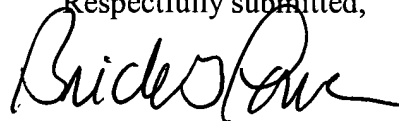
Claims 14, 18, and 19 stand rejected under 35 U.S.C. § 103(a) for reciting subject matter which is purportedly unpatentable over the subject matter taught in Hrzek, in view of teachings from Levine and, further, in view of the teachings of U.S. Patent 6,087,257 to Park et al. (hereinafter “Park”).

Claims 14, 18, and 19 are each allowable, among other reasons, for depending either directly or indirectly from claim 1, which is allowable.

CONCLUSION

It is respectfully submitted that each of claims 1-28 is allowable. An early notice of the allowability of each of these claims is respectfully solicited, as is an indication that the above-referenced application has been passed for issuance. If any issues preventing allowance of the above-referenced application remain which might be resolved by way of a telephone conference, the Office is kindly invited to contact the undersigned attorney.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Brick G. Power", written in a cursive style.

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